Fermilab

Directorate

MEMORANDUM OF UNDERSTANDING

FOR THE 2010 FERMILAB TEST BEAM FACILITY PROGRAM

T-1006

Response and Uniformity Studies of Directly Coupled Tiles

April 2, 2010

TABLE OF CONTENTS

INTRODUCTION

This is a memorandum of understanding between the Fermi National Accelerator Laboratory (Fermilab) and the experimenters of T-1006 who have committed to participate in beam tests to be carried out during the 2010 Fermilab Test Beam Facility program.

The memorandum is intended solely for the purpose of providing a budget estimate and a work allocation for Fermilab, the funding agencies and the participating institutions. It reflects an arrangement that currently is satisfactory to the parties; however, it is recognized and anticipated that changing circumstances of the evolving research program will necessitate revisions. The parties agree to negotiate amendments to this memorandum which will reflect such required adjustments.

Description of Detector and Tests: (by proponents)

A finely-segmented scintillator-based calorimeter which capitalizes on the marriage of proven detection techniques with novel solid-state photo-detector devices such as Multi-pixel Photon Counters (MPPCs) is an interesting calorimetric system from the point of view of future detector design. A calorimeter system consisting of millions of channels will require a high degree of integration. The first steps towards this integration have already been facilitated by the small size and magnetic field immunity of the MPPCs. The photo-conversion occurs right at the tile, thus obviating the need for routing of long clear fibers. Similar considerations apply to the presence of wave-length shifting (WLS) fibers inside the tiles which couple it to the photo-detectors. Significant simplification in construction and assembly ensue if the MPPCs can be coupled directly to the scintillator tiles.

Equally importantly, the total absence of fibers would offer greater flexibility in the choice of the transverse segmentation while enhancing the electro-mechanical integrability of the design. The NIU high-energy physics group has been studying the fiberless or direct-coupling option for some time now. Encouraging results on response and response uniformity have been obtained using radioactive sources. This MOU seeks to set up a framework to extend these tests using beams at the MTBF. The results will be relevant to high granularity scintillator/crystal electromagnetic and hadronic calorimetry.

The tests involve a set of small directly-coupled tile counters fabricated at NIU which will be placed in the beam to study their response and response uniformity as a function of the incident position of the particles passing through them.

I. PERSONNEL AND INSTITUTIONS:

Spokesman and Physicist-in-charge: V. Zutshi
Fermilab Liaison: A. Meyhoefer

The group members at present are:

	Institution	Collaborator	Other commitments
1.1	NIU	F. Abu-ajami	ILC
		G. Blazey	ATLAS, ILC
		S. Cole	ILC
		A. Dyshkant	DØ, ILC
		K. Francis	ILC
		D. Hedin	DØ, ILC
		V. Zutshi	ATLAS, ILC
1.2	Fermilab	S. Kwan	
		P. Rubinov	

II. EXPERIMENTAL AREA, BEAMS AND SCHEDULE CONSIDERATIONS:

2.1 LOCATION

2.1.1 The experiment is to take place in the MTEST beamline and will be situated in the MT6 enclosure. The experimenters' first choice for location in the enclosure is the climate-controlled area MT6-1B which also houses the CAPTAN pixel telescope. Space for a 6U VME crate and power supplies will be needed inside the enclosure.

2.1.1.1 The directly-coupled tile counters will be mounted inside the pixel telescope dark box. The box will also house three pairs of pixel sensor tracking planes.

2.1.2 In addition, the alcove control room to the east of the MTest beamline will be used to house a data acquisition computer and provide a limited amount of work space for three people.

2.2 BEAM

2.2.1 BEAM TYPES AND INTENSITIES

Energy of beam: 120 GeV
Particles: protons
Intensity: 500 – 500,000 particles/spill
Beam spot size: about $10cm^2$

Operationally, the experimenters will most probably request to run at the lower end (500-5000) so as to have as small a number of double particle events as possible.

2.2.2 BEAM SHARING

These tests can run parasitically upstream of other tests as the amount of material added to the beamline will be small (a few centimeters of polystyrene and G10). There will also be the material from the CAPTAN pixel telescope, as usual.

2.2.3 RUNNING TIME

The experimenters request three to four days of running for these tests. Time for setup and installation will also be required.

2.3 EXPERIMENTAL CONDITIONS

2.3.1 SETUP

The detector will consist of up to six layers of 5 or 3 mm thick, 3 cm x 3 cm tiles directly coupled to MPPCs. A layer may contain just one tile or a tile and up to two of its neighbors. Each layer will be assembled as a light-tight unit with the total size of the assembly being approximately 10 cm x 10cm x 24 cm. The module will be mounted on supports allowing for its manual translation and rotation. The supports will be anchored to the pixel telescope dark box. The experimenters would need to access it every 2.5 – 3 hours to manipulate its position.

2.3.2 ELECTRONICS NEEDS

Each tile in the module will be connected to the TB4 electronics board developed at Fermilab with a cable. Since each TB4 board accommodates four channels, three TB4 boards housed in a VME crate will be used. Space and electric power will be needed for the 6U VME crate, power supplies and cables inside the experimental enclosure.

The TB4 electronics will communicate with a computer located inside the alcove counting room with an ethernet cable.

2.3.3 ACCESS

Access to the beam area will be needed periodically for installation and cabling.

2.4 SCHEDULE

The experimenters will initiate these tests in May of 2010 and propose to continue them at a later time if required.

III. RESPONSIBILITIES BY INSTITUTION – NON FERMILAB

3.1 NORTHERN ILLINOIS UNIVERSITY:

10 cm x 10 cm x 24cm tile module with supports	[2K]
Electronics cards (TB4 cards)	[3K]
6U VME crate with controller	[15K]
Scope	[10K]
Pulser	[3K]
Power supplies	[3K]
Cables	[1K]
PC and monitor (DAQ system)	[2K]

IV. RESPONSIBILITIES BY INSTITUTION – FERMILAB

4.1 FERMILAB ACCELERATOR DIVISION:

4.1.1 Use of MTest beam as outlined in Section II.
4.1.2 Maintenance of all existing standard beam line elements (SWICs, loss monitors, etc) instrumentation, controls, clock distribution, and power supplies.
4.1.3 Scalers and beam counter signals should be made available in the counting house.
4.1.4 Reasonable access to the equipment in the MTest beamline.
4.1.5 Connection to beams control console and remote logging (ACNET) should be made available.
4.1.6 The test beam energy and beam line elements will be under the control of the AD Operations Department Main Control Room (MCR).
4.1.7 Position and focus of the beam on the experimental devices under test will be under control of MCR. Control of secondary devices that provide these functions may be delegated to the experimenters as long as it does not violate the Shielding Assessment or provide potential for significant equipment damage.
4.1.8 The integrated effect of running this and other SY120 beams will not reduce the antiproton stacking rate and the neutrino flux by more than 5% globally, with the details of scheduling to be worked out between the experimenters and the Office of Program Planning.

4.2 FERMILAB PARTICLE PHYSICS DIVISION:

4.2.1 The test-beam efforts in this MOU will make use of the Meson Test Beam Facility. Requirements for the beam and user facilities are given in Section II. The Fermilab Particle Physics Division will be responsible for coordinating overall activities in the MTest beam-line, including use of the user beam-line controls, readout of the beam-line detectors, and MTBF gateway computer. [0.5 person weeks]
4.2.2 The experimenters will need help in setting up a fast beam trigger counter, using components already in existence at MTBF or NIU. [0.5 person-weeks]
4.2.3 The experimenters request the integration and synchronization of the TB4 electronics and pixel telescope data streams such that event-by-event reconstruction of tracks passing through the scintillator tiles becomes feasible. [1.0 person-weeks]

4.3 FERMILAB COMPUTING DIVISION

4.3.1 Internet access should be continuously available in the counting house.
4.3.2 Assistance in incorporating the CAPTAN pixel detector readout system into the experimental architecture, if needed. [1.0 person-weeks]

4.4 FERMILAB ES&H SECTION

4.4.1 Assistance with safety reviews.

V. SUMMARY OF COSTS

Source of Funds [$K]	**Equipment**	**Operating**	**Personnel** (person-weeks)
Particle Physics Division			2
Accelerator Division	0	0	0
Computing Division	0	0	1
Totals Fermilab	0	0	3
Totals Non-Fermilab	$39K		

VI. SPECIAL CONSIDERATIONS

6.1 The responsibilities of the Spokesperson and the procedures to be followed by experimenters are found in the Fermilab publication "Procedures for Experimenters": (http://www.fnal.gov/directorate/documents/index.html). The Spokesperson agrees to those responsibilities and to follow the described procedures.

6.2 To carry out the experiment a number of Environmental, Safety and Health (ES&H) reviews are necessary. This includes creating an Operational Readiness Clearance document in conjunction with the standing Particle Physics Division committee. The Spokespersons will follow those procedures in a timely manner, as well as any other requirements put forth by the division's safety officer.

6.3 The spokespersons will ensure at least one person is present at the Meson Test Beam Facility whenever beam is delivered and that this person is knowledgeable about the experiment's hazards.

6.4 All regulations concerning radioactive sources will be followed. No radioactive sources will be carried onto the site or moved without the approval of the Fermilab ES&H section.

6.5 All items in the Fermilab Policy on Computing will be followed by the experimenters. (http://computing.fnal.gov/cd/policy/cpolicy.pdf).

6.6 The Spokespersons will undertake to ensure that no PREP or computing equipment be transferred from the experiment to another use except with the approval of and through the mechanism provided by the Computing Division management. They also undertake to ensure that no modifications of PREP equipment take place without the knowledge and consent of the Computing Division management.

6.7 The experimenters will be responsible for maintaining both the electronics and the computing hardware supplied by them for the experiment. Fermilab will be responsible for repair and maintenance of the Fermilab-supplied electronics listed in Appendix II. Any items for which the experiment requests that Fermilab performs maintenance and repair should appear explicitly in this agreement.

6.8 At the completion of the experiment:

6.8.1 The Spokesperson is responsible for the return of all PREP equipment, computing equipment and non-PREP data acquisition electronics. If the return is not completed after a period of one year after the end of running the Spokesperson will be required to furnish, in writing, an explanation for any non-return.

6.8.2 The experimenters agree to remove their experimental equipment as the Laboratory requests them to. They agree to remove it expeditiously and in compliance with all ES&H requirements, including those related to transportation. All the expenses and personnel for the removal will be borne by the experimenters unless removal requires facilities and personnel not able to be supplied by them, such a rigging, crane operation, etc.

6.9 The experimenters will assist the Fermilab Divisions and Sections with the disposition of any articles left in the offices they occupied.

6.10 An experimenter will be available to report on the test beam effort at a Fermilab All Experimenters' Meeting.

SIGNATURES:

_____ / / 2010
Vishnu Zutshi, Spokesperson

_____ / / 2010
Michael Lindgren, Particle Physics Division

_____ / / 2010
Roger Dixon, Accelerator Division

_____ / / 2010
Peter Cooper, Computing Division

_____ / / 2010
Nancy Grossman, ES&H Section

_____ / /2010
Greg Bock, Associate Director, Fermilab

_____ / /2010
Steven Holmes, Associate Director, Fermilab

APPENDIX I: - HAZARD IDENTIFICATION CHECKLIST

Items for which there is anticipated need have been checked.

Cryogenics		**Electrical Equipment**		**Flammable Gases or Liquids**	
	Beam line magnets		Cryo/Electrical devices	Type:	
	Analysis magnets		capacitor banks	Flow rate:	
	Target	**X**	high voltage	Capacity:	
	Bubble chamber	**X**	exposed equipment over 50 V	**Hazardous/Toxic Materials**	
Pressure Vessels		**Other Gas Emissions**		List hazardous/toxic materials planned for use in a beam line or experimental enclosure:	
	inside diameter	Type:			
	operating pressure	Flow rate:			
	window material	Capacity:			
	window thickness	**Radioactive Sources**			
Vacuum Vessels			permanent installation	**Target Materials**	
	inside diameter		temporary use		Beryllium (Be)
	operating pressure	Type:			Lithium (Li)
	window material	Strength:			Mercury (Hg)
	window thickness	**Hazardous Chemicals**			Lead (Pb)
Lasers			Cyanide plating materials		Tungsten (W)
	Permanent installation		Scintillation Oil		Uranium (U)
	Temporary installation		PCBs		Other
	Calibration		Methane	**Mechanical Structures**	
	Alignment		TMAE		Lifting devices
type:			TEA	**X**	Motion controllers - manual
Wattage:			photographic developers		scaffolding/elevated platforms
class:			Other: Activated Water?		Others